Stem seals

The how (and why) of maintenance
Part 6

By Ingolf Fra Holmslet

The case with the six valves in the previous article is only one of many examples where the lack of proper maintenance / preservation of the valves was the reason behind the problems. There are many different agendas when it comes to building a plant and one is to get the investment cost as low as possible, but as we all know, we get what we pay for.

I don´t say you should go bananas, but you should look carefully at the reasons for your valve problems and find out what the root causes are. There is something true in the old saying: *Nothing is too expensive if you get what you need, but it's a total loss if you can't use what you bought cheaply*. And if you add a shut down and the time loss of production you end up using far more than the former "too expensive" solution would have cost you.

Nothing is too expensive if you get what you need, but it´s a total loss if you can't use what you bought cheaply

As we all know designing and producing a high-pressure valve is difficult. The dimensions, material quality, weight, flexibility of the material, pipe stress, pressure and temperature all make their contribution to the challenges. And on top of all that there are the challenges of the soft seals. The valve needs a soft seal to allow for the operation, movement of the stem with a static seal that suddenly goes dynamic, and then we have the radial seals on the seats.

For a stem seal there are several solutions like O-rings (Figure 26), graphite rings (Figure 27), lip seals (Figure 28) or chevron rings (Figure 29), or it could be a combination of two or more such as illustrated in Figure 30 which combines a lip seal as the primary seal and an O-ring as the secondary seal. In Figure 31 there is a combination of graphite rings and chevron rings of different qualities. Some of the seal types are compressible like the graphite and some are not compressible like the lip seal or chevron rings. The non-compressible seals, which seals by means of pressure, must have a pre-tension towards the stem and bonnet for the seal to function as it should.
In many cases it´s stated from the valve manufacturer that the stem seals are lubricated for life and for that reason need no

Figure 26

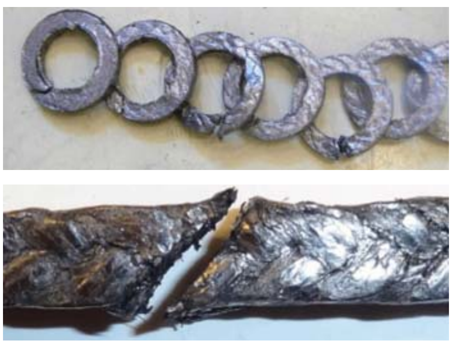

Figure 27

Figure 28

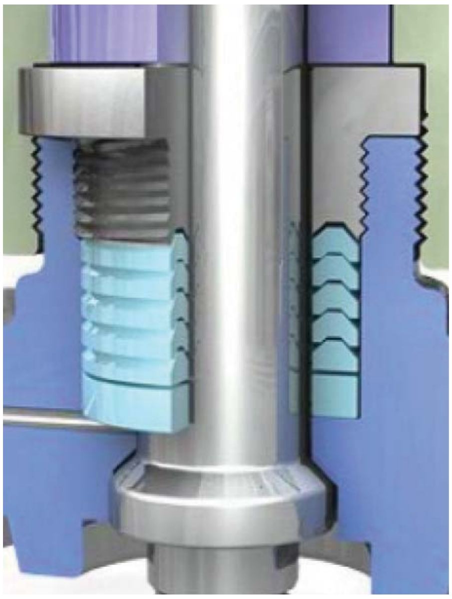

Figure 29

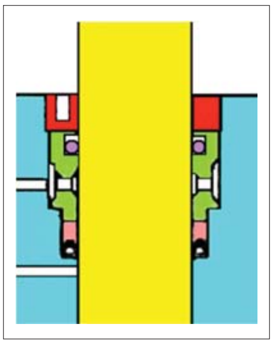

Figure 30

Figure 31

lubrication fitting. The first part is true and the only objection to it is that the life can be short. The second part is totally wrong; most valves should be equipped with a lubrication fitting to the stem. In all cases lubrication will reduce operational wear and prolong the lifetime of the seals. But in addition to the lubricating possibilities of the stem seal you will also have the possibility of using sealing component in case of a stem leak.

If you are planning for maintenance in case of a stem leak in the future, you also must select the proper type and arrangement of the stem seal. The seal arrangement and seal type depends on the medium and type of stem on the valve. The stem can be a stationary one on a parallel gate valve or on a ball valve. In the case of a stationary stem on a parallel gate valve there can be from a few up to a hundred rotations on the stem, compared to a ball valve which will only have ¼ turn from open to closed. The stem can also be a rising stem which moves up and down. The worst stem movements are rising and rotating as on most globe valves, which is probably the cause of the fact that globe valves are the type that have the most reported stem leaks.

Looking at the ¼ turn of the trunnion mounted ball valve there are many seal solutions that could be chosen, like the one in Figure 32 which is a combination of O-rings and lip seal, or the one in Figure 33 which is a double set of O-rings. But it is not the seal type that is important in this case, what is important is the fact that both solutions do have a lubrication fitting installed in the bonnet. This enables you to inject a non-hardening sealing component in between the stem seals. In Figure 32 the seals are installed in a lantern which allows the sealing component to be spread all around the stem and create a good seal.

In both Figures 32 and 33 the injection canal enters in between the two seals. I would prefer the canal to enter below the lower seal allowing the sealing component to go down to the thrust bearing of the stem. When the sealing component enters in between two seals it can sometimes be difficult to fill the whole volume between the two seals with sealing component.

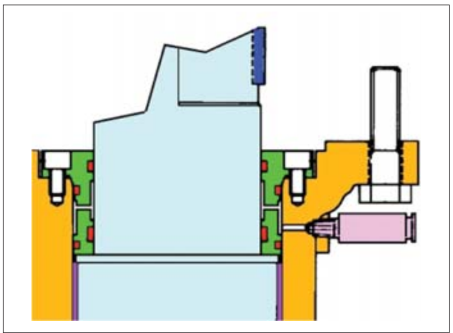

Figure 32

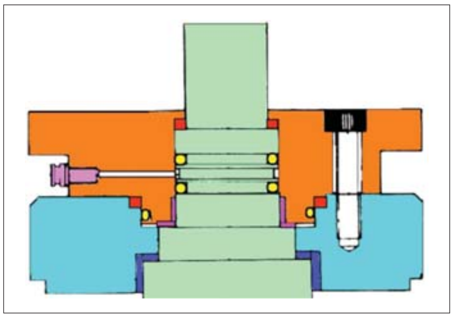

Figure 33

It´s very important that the sealing component **does not** dry out, it must be soft and flexible otherwise it will shortly start to leak.

There is a difference between rising and rotating stems when it comes to parallel gate valves. The stationary stem in Figure 34 only moves by rotating but the rising stem in Figure 35 is moved up and down when opening and closing the valve. Due to the movement of the stem the seals must be slightly different. The upper chevron stack is installed with the lips pointing

It´s very important that the sealing component does not dry out

down on both valves, but the lower stack in Figure 34 points down and the lower stack in Figure 35 points up.

The reasons for this are easy to see if one imagines injecting sealing component to the seal of a leaking stem. If the seal installation in Figure 34 was on a rising stem the injected sealing component would be dragged down when the stem was operated down-ward

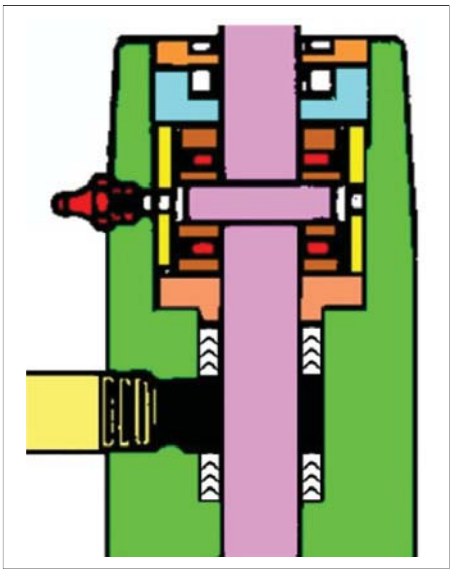

Figure 34

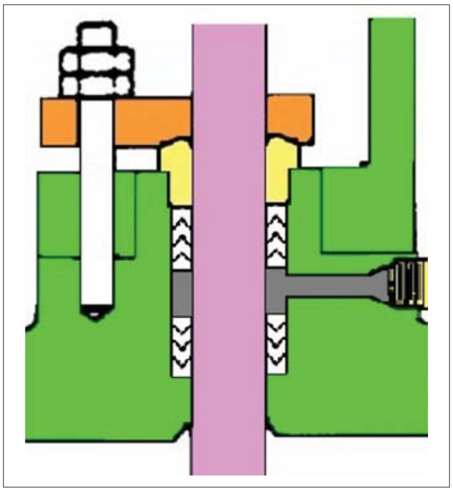

Figure 35

and the leak would reoccur. But if the lower stack was installed as in Figure 35 the sealing component would be locked in between both stacks when the stem was moving up and down. As long as the stem only rotates like the one in Figure 34 the cavity pressure will hold the sealing component in place and seal off any stem-leak. If the seal stack contained a lantern-ring as in Figure 31, it would be easier to inject the proper amount of lubricant/sealing component all around the stem. But there are drawbacks one must be aware of: When injecting sealing component into the construction in Figure 34 excessive sealing component will bypass the lower stack and just go into the cavity, but if injecting too much sealing component, or too fast, there can be a pressure build up that prevents the valve from operating properly.

If injecting anything into the stem or the seat lubrication fittings the personnel must be trained for the job and the pump should always be equipped with a gauge so the person doing the job is in control of the situation.

To be continued…

Norwegian consultant and valve instructor, Ingolf Fra Holmslet, writes a series of articles for Valve World.

Klyde Consultants AS
www.valve.no
Ingolf@valve.no